NEW AND RARE FRESHWATER ALGÆ.

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(Plates liv.-lviii.; and eleven Text-figures.)

In the following notes are embodied observations on a number of new and rare freshwater algæ, that have come under my notice during the last few years. Of those mentioned, a little over two-thirds of the new forms, and about half the others, are from Lismore, the gleanings of 23 gatherings made during the summers of 1916 and 1917: to be precise, from Sept. 16th, 1916, to May 14th, 1917, and from Sept. 21st, 1917, to Feb. 10th, 1918. During the colder months of May, June, July, and August, very little of interest is to be found. The others are from older samples, also locally obtained, or out of still earlier gatherings from Sydney. In all, 66 new forms are described and figured, 28 being admitted to specific rank, 29 classed as variations, and 9 as forms; one new genus is proposed. The figures are, of course, all drawn from Australian specimens.

Habitats.—The districts from which the various forms have been obtained are purely of local interest, but more general value attaches to the character of the habitat. The numbered gatherings, referred to, are accordingly classified as follows. Plankton: 80, 81, 90, 99, 100, 115, 121, 136, 258, 265, 266, 311, 316, 327, 328, 332, 340*a*, 347, 362. Out of weeds (practically plankton): 3, 26, 50, 158, 184, 189, 193, 272, 317. Mucous strata: 306, 323, 326. Ponds, lagoons, and swamps account for the remaining twenty.

One of these last, a swampy pool formed entirely by surface-water, deserves special mention; during the two summers, it was responsible for 30 out of the 64 new forms here described. The samples which refer to it are 284, 286, 298, 302, 308, 311, 312,

316, 317, 327, 337, 340*a*, 345, 347, 352. The pool is the drainage of a considerable area of ground swampy after rain, and is about 2 feet deep in the centre; in droughty weather, it is often entirely dry.*

On account of its unpromising appearance, and to secure everything that might be present, a quantity of water was taken from a spot where there was a growth of coarse weeds, the weeds being well shaken up, and the bottom disturbed also to some extent. This water was strained through a plankton-net of common calico, ground-samples from the swamp being sometimes added. Several gallons would be treated in this way, and the last quart, or so, of water and sediment taken home in a tin and decanted.

During the periods mentioned above, a gathering was taken, on an average, once a month, the main portion of the water being drawn from the same spot. The results show the importance of a regular periodic examination of a pond. The desmids and diatoms were fairly constant, but the *Myxophyceæ*, *Volvocaceæ*, and *Protococcoideæ* presented, from month to month, an apparently endless succession of forms, new, uncommon, or not previously recorded. Rarely could any of these be noted in two successive gatherings, and very often they were never seen again. For instance, of *Chlamydomonas*, 10 different forms, new or rare, were noted; of *Carteria*, 5; of *Phacotus*, 2; of *Volvox*, 2; of *Oocystis*, 7; of *Tetraëdron*, 7; of *Geminella*, 4. Yet, in two summers, the most that could be said was, that a few of them had been recorded a second time.

Of course the swamp, with its ever-changing conditions of life, is the real breeding-ground of all these forms, the pool being only the repository of them, *Chlamydomonas* and *Carteria* are notoriously dependent on rainfall, and are very sensitive to stagnation; but I find that forms of *Oocystis* and *Tetraëdron* are just as irregular in their appearance. Probably, the reason is

* Swampy pools of this sort are the best places to search for new and rare forms of microscopic life; permanent waters, on the other hand, can generally be relied on to yield a micro-flora and fauna of unvarying character.

to be found in the propagation of all these genera by autospores. To begin with, the autospores differ slightly (and sometimes more than slightly) from the parent-cell, and their subsequent development along diverging lines will, no doubt, result in more or less widely differing forms.

Another interesting point to be noted is, that now and again one or other of these forms would be recorded *at the same time* from some other pool connected with an entirely different watershed, or even in another part of the neighbourhood, but they were just as evanescent.

MYXOPHYCEÆ.

Syn. *Phycochromophyceæ*, *Cyanophyceæ*, *Schizophyceæ*.

Fam. CHROOCOCCACEÆ.

Genus Synechococcus Näg.

Synechococcus grandis, n.sp. (Text-fig. 1).

Cellulæ magnæ, crassæ, oblongo-ovales; apicibus late-rotundatis; lateribus arcuatis; cytoplasmate æruginoso, granuloso.

Text-fig. 1.*

Long. 33, lat. 23μ. Lismore (345).

Of Nägeli's three species (Gatt. einz. Alg., p.56, T. i.E, f.1-3), none are over 20μ long. *S. major* Schröter, the nearest in size, is cylindrical. *See* G. S. West, Br. Frw. Alg., p.347, f.161D, E.

Genus Merismopedium Meyen.

Merismopedium punctatum Meyen. (Text-fig. 2*a*).

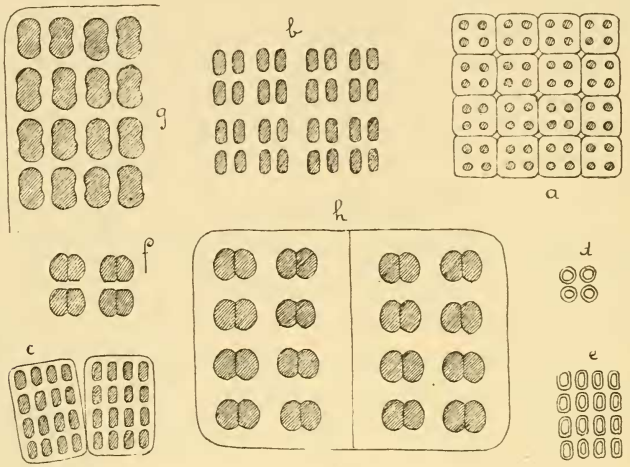
In Wiegm., Archiv, 1839, p.67, *sec.* Rabenhorst, Fl. Eur. Alg., ii., p.57. Syn., *M. Kützingii* Näg., *l.c.*, p.55, T. i.D, f.2. Contents generally pale blue. Usually found in our waters in isolated sets of four cells. As figured, however, out of weeds in the river, the cells were in large sheets but still semi-detached in cœnobia of 4.

Cell. diam. 2μ. Lismore, Richmond R. (272).

* *Synechococcus grandis*, n.sp., (×660).

Var. OBLONGUM Playf. (Text-fig.2*b*, *c*).

Biol. Richm. River, p.135. Generally sparsely distributed in isolated sets of 4, or more rarely of 16. The latter were frequent in plankton from the Nymboidia River, near Grafton, where I



Text-fig.2.

(*a*) *Merismopedium punctatum* Meyen, forma, (×500); (*b*, *c*) var. *oblongum* Playf., (*b* ×1000, *c* ×660); (*d*, *e*) var. *vacuolatum*, n.var., (×660); (*f*) *M. cyaneum*, n.sp., (×660); (*g*) *M. elegans* var. *constrictum*, n.var., (×660); (*h*) *M. duplex*, n.sp., (×1330).

even noted a large cœnobium (30 × 20μ) of four sets of 16 cells each. The cells are irregularly oblong, the contents pale blue.

Cell. long. 2-3, lat. 1½-2μ (plerumque 3 × 2μ).

Lismore (350); Grafton (265, 266).

Var. VACUOLATUM, n.var. (Text-fig.2*d*, *e*).

Cellulæ globosæ vel oblongæ; media cellula loco vacuo magno occupata.

Cell. diam. 2μ; vel long. 3, lat. 2μ. Lismore (350).

The cells are irregularly globose or oblong, and the centre is occupied by a large vacuole giving each cell the appearance of a ring. Globose and oblong cells are sometimes mixed in the same cœnobium.

MERISMOPEDIUM CYANEUM, n.sp. (Text-fig. 2*f*).

Cellulæ ovales vel oblongæ; cytoplasmate cyaneo.

Cell. long. 5-6, lat 3*μ*. Potts Hill (121).

Cœnobium of 4 cells measured 12 × 6*μ*, the cells not quite divided; the colour of the cell-contents a strong bright blue.

MERISMOPEDIUM ELEGANS v. CONSTRICTUM, n.var. (Text.fig. 2*g*).

Cœnobium membranaceum, extensum, e cellulis permultis, confertis, compositum; cellulis oblongis medio constrictis; cytoplasmate dilute cæruleo vel dilute viridi.

Cœnob. long. c. 300, lat. c. 200; cell. long. 6-7, lat. 4-5*μ*.

Lismore, Richmond R. (184, 193).

The cœnobia were wide-spreading, containing 1024 cells (32 × 32) or so. Cells oblong, constricted in the middle, pale blue or pale green. A few cells of the type present, oblong, not constricted, 6 × 4*μ*.

MERISMOPEDIUM DUPLEX, n.sp. (Text-fig. 2*h*).

Cellulæ sphæricæ vel ovales, remotæ; cytoplasmate dilute cæruleo.

Cell. long. 4, lat. 3*μ* Coogee (4).

Cœnobia small, about 30 × 25*μ*, consisting of 8-32 cells generally found half-divided, remote. Contents pale blue.

Fam. OSCILLATORIACEÆ.

Genus OSCILLATORIA Vaucher.

OSCILLATORIA FLEXA, n.sp. (Pl. liv., fig. 1).

Stratum mucosum, foliaceum, saturate viride; filis arcte intricatis rectis, juxta apices subito deflexis, haud attenuatis, apicibus rotundatis, vaginis tenuissimis; trichomatis dilutissime ærugineis, ad genicula haud constrictis; articulis subquadratis vel cylindraceis; dissepimentis ægre cernendis, haud granulatis; cytoplasmate tenui-granuloso.

Diam. fil. 2½-3, cell. alt. 2-8*μ*. Lismore (317).

A mucous stratum of dark green flakes in shallow water at the grassy edge of a swampy pool, in quantity. The filaments were very lively under the microscope, as is usual with species of

this genus; and the sheath, though very delicate, was quite distinct in broken filaments. I have always found it so, even in the finest species of *Oscillatoria*. The filaments, in general quite straight, were bent suddenly about 10μ from the end, which was not attenuated.

Oscillatoria simplicissima v. granulata, n.var. (Pl. liv., f.2).

Forma dissepimentis tenuissime granulatis.

Diam. fil. 8, cell. alt. 4-6 (plerumque 4μ).

Lismore (327).

Filaments free-floating in prodigious quantities, colour pale grey-green, contents finely granular, as also are the dissepiments.

Var. constricta, n.var. (Pl. liv., f.3).

Forma trichomatis ad genicula levissime constrictis.

Diam. fil. 13, cell. alt. 4-8μ. Lismore (350).

Filaments free-floating, more than half as broad again as in the type, with the cells slightly constricted, a mere nick at the edge. Colour pale blue, contents homogeneous not granular. Type in Gomont, Monog. d. Oscillariées, p.219, Pl. vii., f.1.

Oscillatoria princeps Vauch. (Pl. liv., f.4).

Diam. fil. 30-57, cell. alt. 4-8μ. Lismore (350, 352).

Colour pale grey-blue or grey-green. I mention this species for the sake of giving a figure of a piece of empty sheath showing fixed dissepiments right across, with incipient intermediate ones. In surface-view, the septa appeared as faint transverse lines, but, in optical section, they showed bulging to one end, as if the cells had been violently forced out.

Genus Phormidium Kütz.

Phormidium grande, n.sp. (Pl. liv., f.5).

Stratum papyraceum olivaceum; filis rectis, apicibus rotundatis, calyptra nulla, vaginis plerumque crassis; trichomatis saturate viridibus interdum luteolo-viridibus, ad genicula haud constrictis; articulis brevissimis; dissepimentis latis, haud granulatis; cytoplasmate tenui-granuloso.

Diam. fil. 21-23, trich. 19-20, cell. alt. $1\frac{1}{2}$-$2\frac{1}{2}$ (plerumque 2μ).
Lismore (323).

An olive-green papyraceous stratum in great quantities on the surface of a creek-pool, after heavy rain followed by heat. The trichomes under the microscope were of a brilliant green colour (very unusual in this family, but found also in *O. nigro-viridis*) or sometimes yellow-green. The tips of the filaments were sometimes rounded, but generally slightly constricted at the terminal cell so as to be subcapitate.

PHORMIDIUM NUMARIUM, n.sp. (Pl. liv., f.6, 7).

Stratum papyraceum olivaceum; filis angustissimis arcte intricatis, vaginis tenuissimis, apicibus rotundatis; trichomatis dilute cæruleis, ad genicula valde constrictis, articulis brevissimis disjunctis; cytoplasmate homogeneo.

Diam. fil. 2, cell. alt. $\frac{1}{2}$-$1\frac{1}{2}\mu$. Lismore (326).

An olive-green papyraceous stratum on the curb-stone near a down-pipe. The cells of the trichomes are disjoined and are of the palisade-type, reminding one of a *roulean* of coin, at most quadrate before division, only to be distinctly made out with the $\frac{1}{12}$ obj., the contents homogeneous, pale blue with a darker band at the sides.

Fam. NOSTOCACEÆ.

Genus ANABÆNA Bory.

ANABÆNA AUSTRALICA, n.sp. (Pl. liv., f.8, 9).

Trichomata angusta, recta, libere natantia, ad genicula levissime constricta; cellulis rectangularibus, adpressis, apicibus truncatis; cytoplasmate dilutissime cæruleo pæne hyalino, homogeneo vel minutissime granulato; heterocystidibus angustis cylindraceis, apicibus rotundato-truncatis; gonidiis angustis cylindraceis, apicibus rotundatis, lateribus parallelis, juxta heterocystides ordinatis; cytoplasmate pulchre cyaneo, granulato.

Cell. diam. 3-4, alt. 6-10, plerumque 8; heterocyst. diam. 4-5, alt. $10\frac{1}{2}$-15; gonid. diam. 5-7, alt. 19-32μ.

Lismore (327, 337).

Found free, floating. Trichomes narrow, very pale blue,

almost hyaline, with cells so strictly rectangular and so closely adpressed that the trichome has the appearance of an *Oscillatoria*; the slight constriction at the joints, a mere nick at the edge, is discernible only with the $\frac{1}{12}$ obj. (often the dissepiments also): contents homogeneous or finely granular. Heterocysts narrow, strictly cylindrical. Gonidia one or two on either side of a heterocyst, narrow, cylindrical; contents bright blue, granular.

Var. CONSTRICTA, n.var. (Pl. liv., f.10).

Forma gonidiis in medio constrictis. Cell. diam. 3, alt. 8-10; heterocyst. diam. 4, alt. 11; gonid. diam. 4-6, alt. 19-21μ.

Lismore (350).

A form with rather short gonidia somewhat constricted in the middle.

ANABÆNA VARIABILIS var. CYLINDRACEA, n.var. (Pl. liv., f.11-13).

Trichomata flexuosa, dilute cærulea, ad genicula constricta; cellulis stricte rectangularibus, disjunctis, apicibus truncatis; cytoplasmate minute granulato; heterocystidibus oblongis vel oblongo-cylindraceis, apicibus rotundatis; gonidiis doliformibus, quadratis vel oblongis, disjunctis, apicibus truncatis.

Cell. diam. 3, alt. 4-6; heterocyst. diam. 4-5, alt. $7\frac{1}{2}$-$10\frac{1}{2}$; gonid. diam. 6, alt. 7-$10\frac{1}{2}\mu$. Lismore (316).

Easily recognised as *A. variabilis* by its catenate gonidia remote from the heterocysts, differing from the type, however, in its rectangular cells. All parts of the trichome also seem to be slightly more slender than usual. The gonidia were perhaps immature, and would probably become oblong with rounded ends.

ANABÆNA OSCILLARIOIDES var. CRASSA, n.var. (Pl. liv., f.14).

Forma cellulis crassioribus, globosis (e divisione oblongis vel oblongo-constrictis); cytoplasmate æruginoso; heterocystidibus interdum minoribus, sphæricis; gonidiis oblongis, apicibus rotundatis, cytoplasmate æruginoso granulato.

(1). Cell. diam. 6-8; heterocyst. 4; gonid. diam. 9, alt. 22-23μ. Lismore (298).

(2). Cell. diam. 8-$9\frac{1}{2}$; heterocyst. 8; gonid. diam. 12, alt. 25μ. Lismore (337).

In this form, the cells are broader and the heterocysts sometimes narrower than in the type (cell. diam. 4-6, heterocyst. 6-8, gonid. 8-10μ); *cf.* Bornet et Flahault, Revis. d. Nostoc., p.233; Tilden, Minnesota Algæ, i., p.193, Pl. ix., f.19.

Anabæna laxa var. hortensis, n.var. (Pl. liv., f.15, 16).

Forma heterocystidibus cylindraceis: gonidiis cylindraceis elongatis.

Cell. diam. 6-7, alt. 8-12; heterocyst. 7, alt. 14-16; gonid. 7, alt. 33μ.

Botanic Gardens, Sydney (158).

Cf. *Sphærozyga* (*Anabæna*) *laxa* Rabenhorst, Fl. Eur. Alg., ii., p.193; Tilden, *l.c.*, p.192, Pl. ix., f.18. In the type, the heterocysts are spherical, and the gonidia are shorter. Cell-contents, in our form, pale blue, in the heterocysts and gonidia a deeper blue. Rabenhorst, *l.c.*, gives "*trichomatibus . . . luteo-aerugineis*," and "*sporis . . saturate luteo-viridibus*" for the type.

Genus Cylindrospermum Kütz.

Cylindrospermum stagnale v. australe, n.var. (Pl. liv., f.17-21).

Forma cellulis cylindraceis, disjunctis, apicibus truncatis: heterocystidibus oblongo-cylindraceis vel conicis; gonidiis oblongis vel oblongo-cylindraceis, apicibus rotundatis, cytoplasmate pulchre cyaneo vel dilute viridi.

(1). Cell. diam. 4-5, alt. 5-10 (plerumque 7-8); heterocyst. diam. 4-6, alt. 8-11; gonid. diam. 9-13, alt. 18-30μ. Lismore (302).

(2). Cell. diam. 3, alt. 4-10 (plerumque 4-5); heterocyst. diam. 3-4, alt. 7-14; gonid. diam. 7½-9½, alt. 11-12μ. Lismore (306).

Cf. G. S. West, Br. Frw. Alg., p.328, f.150; Tilden, Minnesota Algæ, i., p.198, Pl. x., f.2. The type has oblong cells; in this form, they are quadrate or cylindrical. I found it once (sample 306) as a grey-green, foliaceous, mucous stratum at the grassy edge of a swampy pool. Though the cells and heterocysts of the interlaced trichomes were all of the same size and shape, there were intermingled in this one stratum *three distinct types of gonidia*. The most frequent answered exactly to *C. stagnale*; another I have already described as *C. rectangulare*; and the

third seems to be a form of *C. Goetzei* Schmidle. I have accorded these forms specific rank, as it is the general practice, and convenient for classification; besides, what should be characteristic of a species in these plants, if not the shape of the gonidia! Nevertheless, their being intermingled in one mucous stratum indicates that they are merely allotropic forms of one plant, brought about by different modes of growth.

Most of the trichomes in the mucus were merely interlaced, but here and there they were closely coiled in a spiral manner (Pl. liv., f.21). This is not uncommon in free-swimming filaments of the plankton, but very unusual in mucous strata.

CYLINDROSPERMUM RECTANGULARE Playf.

(1). Gonidia thin-walled, rectangular; heterocysts oblong or acutely conical.

Cell. diam. 3, alt. 4-10; heterocyst. 3-4, alt. 7-14; gonid. 4, alt. 14μ.

Lismore (306). (Pl. liv., f.22).

(2). Gonidia thick-walled, cylindrical; heterocysts oblong.

Cell. diam. 4, alt. 5-10 (plerumque 7); heterocyst. 4-6, alt. 8$\frac{1}{2}$-10$\frac{1}{2}$; gonid. diam. 9$\frac{1}{2}$-12, alt. 29-38μ.

Lismore (302). (Pl. liv., f.23).

Cf. Frw. Algæ of the Lismore Distr., these Proceedings, 1915, p.349, f.A.

Var. PARVICELLULA, n.var. (Pl. liv., f.24, 25).

Forma cellulis minimis, plerumque adpressis, quadratis vel diametro brevioribus, cellula apicali acute-conica; heterocystidibus oblongis; gonidiis interdum lateribus paullo arcuatis.

Cell. diam. 2-2$\frac{1}{2}$; heterocyst. 3$\frac{1}{2}$, alt. 7; gonid. 10, alt. 24μ.

Woy Woy (270).

In a gathering kindly sent me by Mr. A. H. S. Lucas. The cells are unusually small for plants of this family; it should be noted, too, that the gonidia are not any smaller on that account. The walls of the latter were incrassate, rufescent and scrobiculate; this takes place with age, however, in the gonidia of every species.

Cylindrospermum Goetzei Schm., forma. (Pl. liv., f.26, 27).

Trichomata angusta, ad genicula constricta; cellulis quadratis vel cylindraceis, disjunctis; heterocystidibus oblongis vel conicis; gonidiis lanceolatis vel subdoliformibus, apicibus angustis truncatis.

Cell. diam. 3-5, alt. 4-10; heterocyst. 3-6, alt. 6-14; gonid. 7-10, alt. 14-22μ. Lismore (306).

C. rectangulare Playf., *partim*, Frw. Alg. Lismore, p.349, f.A. *Cf.* Schmidle, Schiz. Conj. Chlor. in Engler's Flora von Afrika, H. xxii., p.245, T. iv., f.5. In this, as in all other species of the family, the cells and heterocysts may vary much in shape and size, but the form of the gonidia is characteristic. With the three species of *Cylindrospermum* mentioned above, compare *Anabæna oscillarioides* (type), its var. *stenospora* Born. & Flah., and *A. Volzii* Lemm. These show the same three allotropic forms of gonidia in what is, biologically, one species; they are all found here with the same (quadrate or cylindrical) cells and heterocysts, very often also accompanying one another.

Fam. SCYTONEMACEÆ.

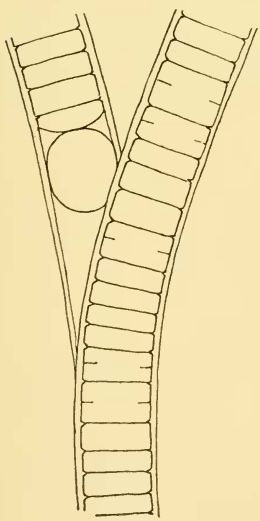
Genus Tolypothrix Kütz.

Tolypothrix lanata (Desv.) Wartmann. (Text-fig.3).

Diam. fil. 15-17, trich. 14; cell. alt.4-8 (plerumque 4); heterocyst. 15 × 14μ.

Grafton, Nymboidia R. (265).

Our specimens agree in dimensions fairly well with those given by Rabenhorst, Fl. Eur. Alg., ii., p.277 (fil. diam. 14-18½, trich. 11-15μ), but the cells are much shorter (equal to, slightly less than, or half as long as the diameter—Rabh.). Sheath colourless, ½ to 1½μ thick, trichomes constricted at the dissepiments, cytoplasm pale green or pale grey-green, very finely granular.



Text-fig.3.—*Tolypothrix lanata* (Desv.) Wartmann; (× 660.

FLAGELLATÆ.

Fam. HYMENOMONADACEÆ.

Genus Synura Ehr.

Synura granulosa Playf. (Pl. lvi., f.1-3).

I give another figure of the cells of this species, that in Frw. Alg. Lismore, Pl. xlv., f.3, being shown too finely granulate. The granules are quite coarse, no more than 16 being visible at the edge, round the anterior margin. Some, that I noted lately, had from 1 to 8 minute dark red, or nearly black, irregular granules at the base of the flagella; or, sometimes, one, larger, simulating a stigma, in the gap between the chloroplasts (Pl. lvi., f.2, 3). The chromatophores in this case were a very pale green without any trace of yellowness, and the cœnobia peculiar in being oblong (not globose and stellate), with the cells attached round a central peduncle. The origin of these oblong cœnobia became clear later, when I found a long cylindrical cœnobium (80μ long by 30μ broad, cells long. 12-20, lat. 6-10μ) with a central mucous or membranous peduncle (Pl. lvi., f.1). The latter being gradually drawn apart by the perpetual twisting of the cells, the cœnobium broke up into two oblong colonies. In the same way, these probably break up into smaller groups, which become regularly stellate by cell-division. The formation of the cœnobia in this genus would appear, therefore, to be on somewhat the same lines as in *Anthophysa vegetans*.

Genus Tessellaria Playf., *nom. emend.*

Cf. Frw. Alg. Lismore, p.315. I find that "*Tessella*" is preoccupied by Ehrenberg for a genus of diatoms; I have altered the name of my new genus, therefore, to *Tessellaria*.

Tessellaria volvocina Playf.

In Pl. lvi., f.4, I give a figure of a yellow-green flagellate evidently belonging to this family, which I think is very probably a free zooid of this organism. In shape globose, truncate in front, diam. 10μ, with two long flagella, two small yellow-green chromatophores confined to the anterior part of the cell, and a number of relatively large refractive globules scattered round

just inside the membrane; membrane very delicate. One c.v. was noted at the side, but perhaps more were present concealed by the globules.

This organism in its early stages seems to be distinctly a plankton-form and to have a fondness for the surface-layer of water. Only later, when the cœnobia have become heavier, do they fall to the bottom and become ground-forms. On the surface of a gathering which was being decanted, I was able to descry, with the help of a Coddington lens and a ray of direct sunlight, quite a miniature world of micro-flora and fauna, among which there turned out to be numbers of *Tessellaria* cœnobia of varying sizes but all small.

Incertæ sedis.

Genus Xanthodiscus Schew.

Xanthodiscus Lauterbachi Schew. (Pl. lvi., f.5, 6).

Schewiakow, Geogr. Verbreit. d. Süsswasserprotozoen, Mem. Acad. sc. de St. Pétersbourg, Sér. 7, T. xli., 1893. A rare flagellate, about whose position and characteristics there seems to be some uncertainty. Wille, Conj. und Chlorph., p.21 (in Engler & Prantl, Die naturlichen Pflanzenfamilien) has placed it as a doubtful genus of the *Volvocaceæ*, relying, apparently, on a certain similarity to *Chlamydomonas* in the arrangement of the cell-contents (fig.7D, E). I first obtained it in great abundance out of *Myriophyllum* in the Orphan School Creek, near Canley Vale Railway-station (March, 1909), and afterwards from Fairfield; I have noted it also from Gardener's Road, Botany. Unfortunately, the disposition of the contents was vague, and my lenses at that time not good enough to distinguish any details. My recollection is, that the chromatophores were pale yellow-green (not brown-green as described). One point, however, which is quite certain, has not been noted either in the figure or description (*l.c.*), viz., that the cell-wall is in two parts, as in *Phacotus*, merely agglutinated together. The organism appears to be a freshwater survival of a large marine family of flagellates —the *Prorocentraceæ*—distantly related to the *Peridiniæ*.

Stein, in Naturg. d. Flagell., ii., T. i., f.27-33, figures it as *Dinopyxis lævis* Stein. He shows a pair of c.v. in front; the large posterior globule, he considers the nucleus; and the smaller central bodies, pyrenoids (two appear in his figures). Lemmermann, however, Reise n.d. Pacific, p.361, mentions *Dinopyxis lævis* as a synonym of *Exuviella Lima* (Ehr.) Schütt, (*Cryptomonas Lima* Ehr.), quoting Schütt, Gymnodiniaceæ, p.8, fig.9 (in Engler & Prantl, *l.c.*). Schewiakow's genus and species, therefore, would seem to be invalid. As a freshwater form, it is known only from Australia.

CONJUGATÆ.

Genus Spirogyra Link.

Spirogyra Lismorensis Playf.

Biol. Richm. River, p.28, Pl. iii., f.1. Noted also from the Nymboidia River (Grafton Water-supply), infertile. It seems, therefore, to be a plankton-form.

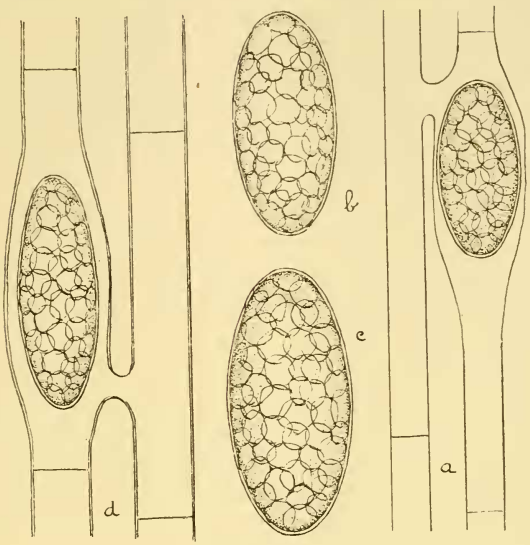
Spirogyra mirabilis (Hass.) Kütz. (Text-fig.4).

Diam. cell. veg. 15-23, alt. 230-245; cell. fruct. max. 25-42, alt. 180-190; zygosp. 21-34, alt. 44-93μ.

Lismore (308).

Cf. Petit, Spir. de Paris, p.14, Pl. iii., f.3, 4; Borge (in Pascher, Süsswasserfl. Deutschl.) *Zygnemales*, p.21, f.17. This seems to be the first record of the conjugation of *Sp. mirabilis*, as Borge, *l.c.*, 1913, says "*Kopulation nicht bekannt.*" The vegetative cells were very long, 10-16 times the diameter; there was one chloroplast making $3\frac{1}{2}$-4 turns. With this species should be compared *Sp. Spreeiana* Rabh. The two are so very much alike, both in characteristics and dimensions, that, in spite of the replicate cell-ends of the latter, I am not convinced that they are distinct species. Moreover, Hirn, Finländischen Zygnemaceen, p.11, f.4, in *Sp. kuusamoënsis* (= a more slender form of *Sp. Spreeiana*) and in *Sp. Spreeiana* itself, *l.c.*, p.12, f.5, shows both simple and replicate septa in the same filament. So also Borge, in *Spirogyra* spp., Sibiriens Chloroph., p. 8, f. 2, 3 (= *Sp. Spreeiana* stouter

form. For convenience of comparison, I append a Table of the



Text-fig. 4.

Spirogyra mirabilis (Hass.) Kütz ; (*a*) conjugated cells (× 330); (*b*, *c*) two sizes of zygospore, (*b* × 660, *c* × 500); (*d*) form with broader filaments and larger, more slender zygospore, (× 330),

dimensions of all these forms; in the characters of the cells, chloroplasts, and zygospores they are all one.

	Diam.		Zygo.	
	cell. veg.	cell. fruct.	diam.	alt.
Sp. mirabilis ...	18-27	··—42	24-29 aplano.	1½-2 plo.
Ours	15-23	25-42	21-34	44-93 2-3 plo.
Sp. Spreeiana (Borge, *Zygnem.*)	18-24	30-42	30-36	2-3 plo.
Sp. kuusamoënsis...	13-17	25-40	23-33	45-75 2-3 plo.
Spirogyra spp., Borge	26-31	? 40-48	39-46	97-118 2½ plo.

Let *Sp. kuusamoënsis* be united with *Sp. Spreeiana*, and our

specimens agree perfectly with them in all points, as well as with *Sp. mirabilis*.

Spirogyra neglecta (Hass.) Kütz. (Pl. lviii., f.1 13).

A.—Cell. veg. diam. 46-57, alt. 53-360; cell. fruct. diam. ad dissep. 46-57, ad inflation. 65-68, alt. 42-125μ. Zygosporæ ut sequitur:—

a. Zygo. late ovales, long. 52-66, lat. 42-49μ. (Pl. lviii., f.3).

b. Zygo. longius ovales, long. 64-74, lat. 45-51μ. (Pl. lviii., f.4).

c. Zygo. ellipticæ, long. 78-91, lat. 46-51μ. (Pl. lviii., f.5).

d. Zygo. oblongæ, long. 75-80, lat. 45-51μ. (Pl. lviii., f.6).

Lismore (353).

Cf. Petit, *Spirog.* d. Paris, p.26, Pl. ix., f.1-5; Borge, *Zygnemales*, p.29, f.36. In the very short cells, there are generally 3 chloroplasts making 1 turn; in the long cells, 3-5 chloroplasts making 2-3 turns. Three forms of chloroplast also were noted intermixed; all, however, had the central ridge, which is said to be characteristic of the species:—

(1). As in Petit, *l.c.*, a narrow delicate band with minutely irregular edges, and very small, almost indistinguishable, pyrenoids. Only noted in uncopulated cells of fertile filaments. (Pl. lviii., f.7, 8).

(2). A very delicate band with finely fimbriated edges; also with very minute pyrenoids. (Pl. lviii., f.9, 10).

(3). A more robust band with edges irregularly scalloped, not fimbriated, and with large, distinct pyrenoids. (Pl. lviii., f.11-13).

Four distinct shapes of zygospore were noted in this one sample, and, in such profusion, as to be all present under the cover-glass at one time. Inflated sporangial cells, and uninflated, were noted in the same conjugated filament (Pl. lviii., f.1, 2).

B.—Cellulæ vegetativæ paullo crassiores; zygosporis paullo majoribus; chloroplastidibus tenuibus laciniatis.

Cell. veg. diam. 62-64, alt. 70-120; zygo. long. 94-100, lat. 52-56μ. Lismore (297).

A broader specimen than usual, with slightly larger zygospores. In gatherings of *Sp. neglecta* there may generally be noted a few

filaments of *Sp. nitida*, easily distinguished by their greater breadth:—diam. cell. veg. 95-116, alt. 84-360; 3-5 chloroplasts making 2-3 turns, edges scalloped, a central ridge evident here and there, large pyrenoids 6-10 to the half turn. (Lismore, 352, 353, 358). It is not unlikely that they really form one species. *Sp. Fullebornii* Schm., Alg. aus Nyassasee, p.76, T. iii., f.2 (fil. diam. 40-42, zygo. 64-80 × 40μ) seems to me a somewhat narrower form of *Sp. neglecta*.

Var. AMYLACEA, n.var. (Pl. lviii., f.14-16).

Cellulæ vegetativæ chloroplastidibus amylo suffusis, in granula fractis; pyrenoidibus maximis, granulosis.

Cell. veg. diam. 46-54, alt. 60-260; zygo. long. 74-90, lat. 48-50μ. Lismore (271).

In this form, the chloroplasts have become impregnated with amylum, and have broken up into minute irregular grains. The central ridge, however, is generally still noticeable, and the pyrenoids are very large (up to 10-12μ), and granular as in *Closterium lunula*. The whole of this gathering was of the same character. The zygospores present were long-elliptic with pointed ends, lying diagonally in short oblong cells which were not inflated (as in Pl. lviii., f.1). Probably, however, all the various forms of zygospore detailed above for the type will be found also in this variation. Chloroplasts 2-3, making $1\frac{1}{2}$ to $3\frac{1}{2}$ turns in the cell.

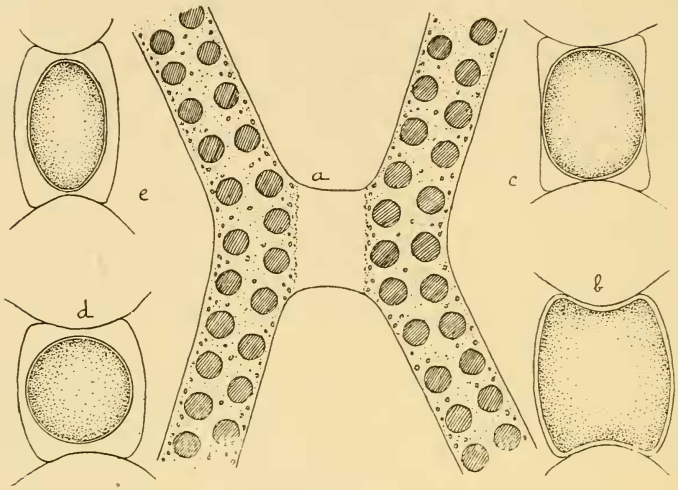
Genus MOUGEOTIA (Ag.) Wittr.

MOUGEOTIA LÆTEVIRENS (A.Br.) Wittr. (Text-fig.5).

Cell. veg. diam. 27-44, alt. 255-408; zygo. long. 61-63, lat. 42-53μ. Botanic Gardens, Sydney (158); Lismore (328, 332).

Cf. Borge, *Zygnemales*, p.40, f.62. In our specimens, the chloroplasts generally have a large number of pyrenoids, either irregularly scattered or arranged in two lines at the edges. This is the only species of *Mougeotia*, as far as I know, in which this occurs. The pyrenoids are sometimes comparatively small (2-4μ) but occasionally very large, diam. 10μ. The contents of the cyst

are generally retracted into an oval (53 × 32μ), oblong (53 × 42μ) or more rarely globular (diam. 42μ) zygospore.



Text-fig. 5.

Mougeotia lætevirens (A. Br.) Wittr.; (*a*) conjugating filaments with unusually large pyrenoids; (*b*, *c*, *d*, *e*) types of zygospores; (all × 330).

CHLOROPHYCEÆ.

Fam. VOLVOCACEÆ.

Genus Carteria Diesing.

Carteria rugulosa, n.sp. (Pl. lv., f. 1, 2).

Cellulæ reniformes, in fronte acuminatæ, a tergo concavæ, angulis posterioribus rotundatis. A vertice late ellipticæ. Membrana paullo rufescens, jugis granulatis convergentibus 12, longitudinaliter dispositis, ornata. Cytoplasma retracto globoso, stigmate juxta apicem.

Long. 17, lat. 23, crass, 17μ. Lismore (311, 312).

A most curious form, noted in some numbers. The cell-wall is much larger than the mass of cytoplasm, and is reniform or rather broadly obcordate in shape, with 12 coarse longitudinal ridges bearing a series of granules. The ridges converge to a point in front and behind. The cell-wall was rufescent, and the

arrangement of the chloroplasts could not be discerned: a distinct stigma near the apex was noted, but no pyrenoid.

Var. ANGULATA, n.var. (Pl. lv., f.3).

Forma ad apicem depressa, in medio depressione papilla instructa; lateribus inferne paullo angulatis; ceteris ut in forma typica.

Long.17, lat. 23μ. Lismore. Cum priori.

A cup-shaped depression with central papilla replaces the pointed apex of the type. The sides run back to a slight angle in the hinder portion.

Var. INÆQUALIS, n.var. (Pl. lv., f.4).

Forma major, ovata, in fronte acuminata, a tergo late-rotundata. Membrana luteo-fuscescens; ceteris ut in forma typica.

Long. 30, lat. 21-25½μ. Lismore. Cum priori.

In all specimens of this form there was a minute projection at one side of the apex. Undoubtedly, I think, this variation is produced by uneven growth, only one lobe of the cell-wall developing; the small subapical projection is the remains of the undeveloped lobe.

CARTERIA MULTIFILIS (Fresen.) Dill. (Pl. lv., f.5, 6).

Cellulæ parvæ sphæricæ; membrana tenuissima vel interdum crassa; papilla nulla nec cytoplasmatis projectione; chloroplastide crasso parietali; pyrenoidi in media cellula.

Diam. cell. 8-11; pyrenoid. 3μ. Lismore (345).

Cf. Fresenius, Beitr. z. Kenntn. mikrosk. Organism., Abh. d. Senckenb. Gesells., 1856, p.235. Goroshankin, Morph. u. System. d. Chlamyd., ii., 1891, p.120, reproduces Fresenius' original description of the type, the chief points of which are:—cell spherical or oval, length 10-16μ, pyrenoid in the centre of the cell, cytoplasm minutely granular, stigma between the apex and the middle, membrane very delicate, close-fitting.

I have not seen Fresenius' figure of the type, but our specimens seem to me in some respects to tally with his description better than other published figures, and specially in this, that they have

a massive parietal chloroplast with a central globular locellus in which the pyrenoid (when present) is situated.* Excellent figures are given by Goroshankin, *l.c.*, Pl. ii., f.14, and by G. S. West, Br. Frw. Alg., p.188, f.73A, B, but in each case the pyrenoid is eccentric. Fresenius says "*In der Mitte ein scharf umschriebener Kern.*" Ours, on the other hand, are smaller, (Rabenhorst, however, reports specimens of 6-8μ diam.) quite spherical and without any apical protuberance. The cell-wall, generally very thin, is sometimes stratified. This species, considered the most common in Europe, is very rare here, in my experience. I obtained it (the only time) from two local ponds in October, 1917, after the spring rains, in some quantity. Though I had assiduously worked these pools for five years previously, I had never seen a sign of it before, nor have I noted it since from either.

CARTERIA BULLULINA, nom.nov.

Syn., *Carteria multifilis*, forma, Australian Frw. Phytoplankt., these Proceedings, 1917, p.824, Pl. lvi., f.1-4. The expression "closely fitting membrane" (*dicht anliegenden Haut*) in Fresenius' description of *C. multifilis* rules out this form from any connection with the latter. My description, *l.c.*, applies to the cell-membrane; the mass of cytoplasm is much smaller and attached at the apex (fig.1). The details of the chloroplast, I have not yet noted.

CARTERIA GRANULOSA, n.sp. (Pl. lv., f.7, 8).

Cellula compressa, fronte visa pæne circulata, superne fissura obliqua instructa; a latere valde compressa, superne in cornua duo divisa, cornibus evolutis. Membrana rufescens, granulosa. Cytoplasma retractum, ad cellulæ apicem affixum, a latere compressum. Pyrenoidis nulla nec stigma (in speciminibus notatis).

Long. 31½, lat. 29½, crass. 10μ. Lismore.

A compressed form, with granulate cell-wall. Above, the cell-wall is divided into two rounded overlapping heads by a deep

* When the pyrenoid, as in this case and many others that I have noticed, is central, it would seem to enclose the nucleus.

oblique cleft. In sideview, both cell-wall and green cell are seen to be compressed, the cell-wall cleft above and the two heads turned outwards. No pyrenoid in the specimens observed. Nucleus and stigma not visible, the membrane strongly rufescent.

Genus Chlamydomonas Ehr.

Chlamydomonas reniformis, n.sp. (Pl. lv., f. 9, 10).

Cellula compressa; fronte visa reniformis ubique rotundata, pone indentata. A latere compressa, ovalis vel ovata. Membrana tenuissima glabra, cytoplasmati arcte adhærens. Pyrenoidis nulla nec stigma (in specimine notato).

Diam. 10½, alt. 8½μ. Lismore (312).

A very curious form, of which I saw but one specimen. It very much resembles *Carteria rugulosa*, and might possibly be a young form of that species. The flagella (2) were very distinct and unusually thick. On the other hand, the cell-wall is closely adherent to the cytoplasm, perfectly smooth and hyaline.

Chlamydomonas Lismorensis v. gracilis, n.var. (Pl. lv., f.11).

Cellula anguste cylindracea, pone rotundata, fronte conica, lateribus parallelis. Chloroplastis parietalis; pyrenoide nulla visa; stigmate distincto inter apicem et medium posito; granulis paucis juxta apicem.

Long. 9½, lat 2½μ. Lismore (345).

The type (these Proceedings, 1917, p.827, Pl. lvi., f.18) is oblong-cylindrical with rounded ends, and proportionately broader. This form is narrower, and conical in front. Chloroplast bright green, homogeneous, parietal; no pyrenoid seen; stigma wick-shaped, very distinct, halfway between the apex and the middle.

Chlamydomonas rotula, n.sp. (Pl. lv., f.12).

Cellula oblonga (vel globosa?) ubique rotundata; in media cellula pyrenoide magna; chloroplastide in discos tenues parietales multos diviso, discis singulis ad pyrenoidem tænia chlorophyllacea connectis; stigmate nullo viso.

Long. 19-21, lat. 15; pyrenoid. 6μ. Lismore (345).

Easily recognised by reason of the extraordinary disposition of

the endochrome. The chloroplast is broken up into a number of very delicate parietal discs, each connected with the large central pyrenoid by a filament narrowing from without inwards. There are about seven discs visible round the margin in optical section. Cf. *Chl. stellata* Dill, Gatt. *Chlamyd.*, p.17, T. v., f.31-36; Wille, Alg. Notizen ix.-xiv., p.134, T. iv., f.4. The latter, however, has a massive chloroplast, and differs considerably in appearance. *Chl. rotula* also has a papilla or apical protuberance. A *Glœocystis*-stage was noted, eight cells in a mucous sphere; the cells were in every respect the same as the zoospore. I have given this species the name "*rotula*," as I have my suspicions that *Oocystis rotula* Playf., is a young *Glœocystis*-stage of it.

Chlamydomonas alpina (Wille) mihi. (Pl. lv., f.13).

Chloromonas alpina Wille, Alg. Notizen ix.-xiv., p.152, T. iii., f.24-34.

Cell. long. $10\frac{1}{2}$, lat. 7μ. Lismore.

Noted *both with and without a pyrenoid*, the latter situated close to the posterior end of the cell. The chloroplast-discs are about $2\text{-}3\mu$ in diameter. Two c.v. observed, and an oval orange-coloured stigma in the middle of the cell (near the apex in the type). In the specimen measured, the flagella were very long, quite twice the length of the cell, but I did not notice if they were so in every instance. Noted in winter, among fungoid growth on a rotten stick in swamp-water.

Chlamydomonas caudata Wille. (Pl. lv., f.14).

Algologische Notizen ix.-xiv., p.135, T. iii., f.4-11. The only tailed species of *Chlamydomonas*; it is impossible to make any mistake in the identification. Yet there was *not a trace of a pyrenoid*, though the body was very transparent, and the nucleus distinctly visible. Stigma wanting.

Cell. long. 30, lat. 18; corp. long. 20, lat. 12μ. Lismore (344).

Chlamydomonas maculata, n.sp. (Pl. lv., f.15-17).

Cellulæ sphæricæ, papilla nulla nec projectione apicali; membrana crassa interdum lamellosa; vacuolis contractilibus 2; stigmate distincto, hemisphærico, luteo-fusco, paullo supra medium

posito; nucleo in media cellula. Chloroplastide valida parietali, maculata (superficie externa scrobiculata); pyrenoide plerumque nulla (in speciminibus notatis).

Diam. 15-25; membr. 2-4; cell. matric. 40. autosp. 11-13μ.

Lismore (345, 350).

Compare *Chl. subcaudata* Wille, Alg. Notizen ix.-xiv., p.118, T. iii., f.12-18; W. & G. S. West, Frw. Alg. Brit. Antarct. Exp., p.274, Pl. xxiv., f.25-29. Generally spherical without apical projection; membrane thick, sometimes lamellar in two layers. It is distinguished from *Chl. globulosa* Perty, by the massive parietal chloroplast evenly distributed round the cell-wall except, of course, at the apex, and particularly by the fact that the outer surface of the chloroplast is pitted, giving it a spotted appearance all over. The central locellus is globular. Nucleus central; stigma orange-coloured, a little above the middle; pyrenoid generally wanting. A mother-cell, however, was noted, containing four autospores, of which one had a distinct pyrenoid; in two others, it was faintly indicated, and, in the fourth, it was entirely absent.

Var. OBLONGA, n.var. (Pl lv., f.18).

Cellulæ oblongæ; ceteris ut in forma typica.

Long 16, lat. 13$\frac{1}{2}\mu$. Lismore (350).

Var. PLANKTONICA, n.var. (Pl. lv., f.19).

Cellulæ oblongæ, interdum apicem versus modice angustatæ; humili projectione apicali instructæ, membrana tenuissima arcte adhærente; stigmate nullo nec pyrenoidi (in speciminibus notatis); ceteris ut in forma typica.

Long. 20-26, lat. 13-17μ. Lismore (347).

This form has the same parietal chloroplast with scrobiculæ on the outer surface, but the membrane is very thin; there is a slight apical protuberance, and, in specimens observed, the stigma and pyrenoid were absent.

CHLAMYDOMONAS METASTIGMA Stein. (Pl. lv., f.20).

Forma stigmate luteo-fusco, bacillari, subapicali.

Long. 26, lat. 13μ. Lismore (327).

Cf. Stein, Naturg. d. Flagell., i., T. xv., f.46 : Goroshankin, Morph. u. System. d. *Chlamyd.*, ii., p.131, Pl. iii., f.26: Wille, Alg. Notizen ix.-xiv., p.146, T. iv., f.22. Goroshankin's figure (reproduced by Wille) differs from the type in being a short oval; whereas Stein's figure is a long oval, subcylindrical. Our specimens agree with the type in outline and in proportions (Stein's figure works out at $20 \times 11\mu$), but differs in the position of the stigma, which is near the end in the type, but subapical in ours. Goroshankin makes it hemispherical, here it was wick-shaped. The upper pyrenoid was laterally disposed, and perhaps was geminate, or becoming so; Goroshankin notes the occurrence of two pyrenoids in front.

Chlamydomonas paupercula, n.sp. (Pl. lv., f.21, 22).

Cellulæ longo-ovatæ, subellipticæ, in medio latissimæ, pone paullo angustatæ, fronte conicæ; apice obtuso paullo producto: membrana tenuissima inconspicua arcte adhærente; chloroplastide crassa parietali, granulis sparsis superficie exteriore vel interiore dispositis; stigmate nullo nec pyrenoidi (in speciminibus notatis).

Long. 14-17, lat. 6-8μ. Lismore.

In shape and size, very like *Chl. alboviridis* Stein, Naturg. d. Flagell., i., T. xiv., Abt. vi., f.1, 2, 21; (figures 1, 2 work out at $26 \times 13\mu$, fig.21 at $17 \times 8\mu$). The cell is elliptic, conical in front, the apex obtuse and slightly produced; membrane very thin. The chloroplast is massive and parietal, with scattered granules sometimes on the outer surface, sometimes on the inner. Though viewed with the $\frac{1}{12}$ obj., the nucleus was not discernible; pyrenoid and stigma absent.

Chlamydomonas pusilla, n.sp. (Pl. lv., f.23).

Cellulæ ovatæ, ubique rotundatæ; apice obtuso haud producto; membrana tenuissima, inconspicua, arcte adhærente; chloroplastide crassa, parietali; intus granulata; nucleo in media cellula; stigmate mediano; pyrenoidi nullo viso.

Long. 30, lat. 20μ. Lismore (350).

Cell broadly ovate, rounded off everywhere, obtuse in front and without projection. Chloroplast massive, parietal, granulate

on the inner surface, no pyrenoid in the specimens observed, stigma median. The nearest form seems to be *Chl. media* Klebs, Beding. d. Fortpflanz., p.425, f.12, (Wille, Alg. Notizen ix.-xiv., p.140, T. iv., f.11) which, however, is more pointed in front, and has a subapical stigma and a pyrenoid at the side in the middle.

Chlamydomonas angulosa v. obesa, n.var. (Pl. lv., f.24).

Cellulæ præ latitudine breviores, crassæ, subglobosæ; de singulis rebus ut in forma typica.

Long. 16, lat. 14μ. Lismore (350).

Cf. Dill, Gatt. Chlamyd., p.15, T. v., f.21-25; Wille, *l.c.*, p.141, T. iv., f.13. Our form agrees in all details with Dill's type, but in shape it is subglobose, almost subquadrate, instead of oval. Dill's figure works out at $20 \times 14\mu$.

Chlamydomonas pisiformis v. ocellata, n.var. (Pl. lv., f.25).

Cellulæ ambitu formæ typicæ consimiles; chloroplastide autem parietali; in media cellula locello magno pyrenoidem continente; stigmate nullo viso.

Long. 17, lat. 8½; cell. matric. long. 25, lat. 19μ.

Lismore (350).

Cf. Dill, *l.c.*, p.14, T. 5, f.13-19; Wille, *l.c.*, p.138, T. iv., f. 8. Only noted as autospores, 2, 4, 8 to the mother-cell. In shape, they agree exactly with the type, even to the slight curve to one side, and the apical projection, broad from the front and wick-like from the side. The chloroplast, however, is parietal, and the centre of the cell occupied by a large locellus containing a pyrenoid (diam. 5μ). No stigma, and the nucleus not discernible.

Genus Chlorogonium Ehr.

Chlorogonium minimum, n.sp. (Pl. lv., f.26).

Cellulæ minutæ, gracillimæ, fusiformes, pone acutissimæ, fronte rostratæ; membrana tenuissima, arcte adhærente; chloroplastide tenuissima, homogenea, parietali; in media cellula locello hyalino (?nucleum contingente); flagellis 2, ex apice oblique orientibus; stigmate distincto, bacilliformi, subapicali; pyrenoide nulla.

Long. 30, lat. 2-3μ. Auburn; Lismore (350).

A minute and very slender species, rostrate in front and very acute behind; membrane very delicate. Chloroplast also very delicate, homogeneous, parietal, without pyrenoids. A hyaline space, probably containing the nucleus, in the centre of the cell. Stigma very distinct, wick-shaped, some distance down from the apex. Contractile vacuoles not noted. Flagella 2, going off at right angles close to the tip.

Genus Pteromonas Seligo.

Pteromonas angulosa v. australis Playf.

Syn., *Pt. alata* v. *australis* Playf., Frw. Alg. Lismore, p.335, Pl.42, f.14. *Pt. alata* Seligo, is a synonym, it appears, of *Pt. angulosa* (Carter) Dang., (*Cryptoglena angulosa* Carter, Ann. Nat. Hist., 1859, T.1, f.18*a-c*). The side-view (Pl. lv., f.28) is characteristic of the type and all its forms, *cf.* Chodat, Alg. vertes, p.144, fig.68 E.

Forma. (Pl. lv., f.27, 28).

Membrana a tergo incisa. Long. 22½, lat. 15μ. Lismore(312).

Var. scutiformis, n.var. (Pl. lv., f.29).

Cellulæ membrana oblonga, fronte paullo angustata; lateribus inferne rectis, levissime convergentibus, apicem versus incurvis; apice levissime concavo; angulis posterioribus rectis; basi in medio inflata.

Long. 16, lat. 11; corp. lat. 8μ. Lismore (344).

The enveloping membrane is oblong, with straight sides converging slightly, and drawn together in front, the apex a little concave. Lower angles square, and at the base convex. In all these forms observed here, the chloroplasts, though very pale and thin, showed the characteristic cup-shape. No stigma, however, was present, nor pyrenoid.

Var. vexilliformis, n.var. (Pl. lv., f.30).

Cellulæ membrana fere quadrata; lateribus rectis, parallelis: apice plano; angulis superioribus oblique truncatis; basi convexa;

angulis inferioribus obtusis. Pyrenoides parvæ 2, paullo supra cellulam mediam ad latera dispositæ.

Long. 20, lat. 16, crass. 8: corp. lat. 11μ. Lismore (344).

The envelope is quadrate with convex base, straight parallel sides, flat apex, and the upper angles obliquely truncate. A specimen was noted with two small pyrenoids, on either side one, a little above the centre of the cell. No stigma present. For another example of a pyrenoid on each side, see *Chl. longistigma* Dill, (Wille, *l.c.*, T. iv., f.21).

Genus Phacotus Perty.

Phacotus crassus, n.sp. (Pl. lvi., f.7, 8).

Cellulæ fronte visæ fere circulatæ, margine aspera, ad apicem papilla instructæ; a latere paullulo compressæ, oblongæ, lateribus arcuatis, apicibus late-rotundatis, papilla instructis. Membrana crassa, aspera. Cytoplasma in globo retractum, densum, crasse granulosum; vacuolis contractilibus 2; stigmate nullo nec pyrenoidi.

Long. 22, lat. 19, crass. 14μ. Lismore (311).

Nearly circular in face-view, with apical papilla; oblong somewhat compressed from the side, with broadly rounded ends and arched sides. The membrane is thick, and rough with irregular asperities. The cytoplasm is retracted into a globe beneath the apex, contents dense, coarsely granular, two contractile vacuoles noted but no stigma or pyrenoid.

Phacotus glaber, n.sp. (Pl. lvi., f.9, 10).

Cellulæ fronte visæ fere circulatæ, ad apicem concavæ, papilla instructæ; a latere modice ovato-oblongæ, ad apicem truncatæ, a tergo fere hemisphæricæ, lateribus levissime arcuatis. Membrana crassa, glabra, dilute rufescens. Cytoplasma in globulo parvo ad apicem retractum; stigmate nullo nec pyrenoidi.

Long. 22, lat. 21; cytopl. glob. diam. 9½μ. Lismore (312).

In face-view, nearly circular with a slight concavity, and a papilla at the apex; ovate-oblong from the side, sides slightly arched, apex truncate, hemispherical behind. Membrane smooth,

thick, slightly coloured. Green cell remarkably small, retracted to the apex: no stigma, no pyrenoid.

Forma. (Pl. lvi., f. 11).

Cellulæ fronte visæ haud circulatæ sed modice quadratæ, ubique rotundatæ; ad apicem quam levissime concavæ, papilla nulla; ceteris ut in forma typica.

Long. 21, lat. 19, crass. 14; corp. 13μ. Lismore (312).

Rather rounded-quadrate than circular in face-view, apex very slightly concave, no papilla; other details as in the type.

Forma. (Pl. lvi., f. 12).

Cellulæ ad apicem paullo quadratæ, pone circulatæ; membrana crassa, saturate rufescente; cytoplasmate in massa ovata retracto; chloroplastide parietali intus granulis amylaceis magnis ornata; vacuolis contractilibus distinctis 2; stigmate mediano.

Long. 21, lat. 20; corp. long. 12, lat. 10μ. Lismore (345).

In shape, intermediate between the two forms (*supra*), being broad and "shouldered" above, and circular below. Membrane deeply rufescent; cytoplasm retracted into a small ovate mass; chloroplast parietal, granulate on the inner surface with large granules; stigma distinct, median; two contractile vacuoles distinctly visible. These details are very rarely observable in *Phacotus*.

Phacotus australis, n.sp. (Pl. lvi., f. 13, 14).

Cellulæ fronte visæ fere circulatæ, ad apicem concavæ, papilla instructæ; a latere valde compressæ, ellipticæ, apicibus acute-rotundatis. Membrana tenuis, glabra, dilutissime rufescens. Cytoplasma in massa apicali retractum, a latere visum compressum, ovatum; stigmate nullo nec pyrenoidi.

Long. 20, lat. 21, crass. c. 8μ. Lismore (350).

Almost circular in face-view with a slight apical concavity and papilla: from the side very compressed, elliptic with acutely rounded ends. Membrane thin, smooth, pale biscuit-colour, with a matt surface. Cytoplasm retracted, compressed, ovate, in side-view: no stigma nor pyrenoid.

Genus Spondylomorum Ehr.

Spondylomorum quaternarium Ehr.

Ehrenberg, Beob. zweier generisch. neuer Formen d. Frühlingsgewassers bei Berlin, Monatsber. d. Berl. Acad. d. Wissensch., 1848. *Cf.* Stein, *l.c.*, T. xviii., f.30-34. Syn., *Burkillia cornuta* W. & G. S. West, Frw. Alg. Burma, p.228, Pl. xii., f.19-21; *Uva Casinoënsis* Playf., Biol. Richm. R., p.108, Pl. ii., f.13.

This flagellate seems to be very little known; it is not mentioned either by Chodat in Alg. vertes de la Suisse, 1902; nor by G. S. West in Br. Frw. Algæ, 1904. Lemmermann reports it from a single locality in Sweden, but it is not included in Bachmann's Das Phytoplankton des Süsswassers, 1911. In my former paper, I had not the assistance of Stein's excellent illustrations; also the figure and description of this organism published in the Micrographic Dictionary, p.721, Pl.3, f.23, are entirely incorrect and misleading. The figure here given agrees almost exactly with that by Stein, *l.c.*, f.30, save that the stigma is above, not below, the centre.

The cœnobia are generally oblong, consisting of rings of four cells, arranged one above another. They easily break up either longitudinally or transversely; in the latter case, the resulting cœnobia are often hemispherical or rosette-shaped. The cells, originally globose, very soon become broadly oval or ovate; the membrane is very delicate, and, by reason of their very rapid movement through the water, it is generally drawn out at the back into a short pointed sac, at first very indistinctly outlined. Later, however, it becomes stouter and more evident. The chloroplast is cup-shaped, generally without a pyrenoid; there is a central nucleus, two apical contractile vacuoles, and a stigma, median or a little above or below the midline. The internal details, however, are not easily seen, as the cytoplasm is generally very dense. In a zooid which became detached from a cœnobium, I was able to see distinctly that there are two unusually long apical flagella. Noted from at least four different spots round Lismore.

Cœnob. long. 28-40, lat. 22-27; cell. long. 10-20, lat. 6-12μ.

Merrylands (Sydney); Casino (189): Lismore (237, 246, 307, 344).

Var. ROSTRATUM, n.var. (Pl. lvi., f.16, 17).

Cellulæ plerumque 4-8 in fascina conjunctæ, fronte globosæ, pone in rostrum acutum levissime curvatum productæ. Cum forma typica atque ejusdem dimensionis.

Cœnobia generally small, with a few cells in a bunch or rosette; cells globose in front, and behind drawn out into a sharp-pointed slightly curved beak; cytoplasm and chloroplast filling the whole cell, only the tip hyaline. Generally no pyrenoid or stigma.

Genus VOLVULINA Playf.

VOLVULINA STEINII Playf. (Pl. lvi., f.18).

Cœnob. diam. 70, cell. diam. 15, alt. 12μ. Lismore (350).

In a cœnobium of the type with very transparent pale green cells, a minute central nucleus could be observed. The flagella originated close together, and, *at their base*, two contractile vacuoles, as in Stein, *l.c.* In some cells, a large orange-coloured stigma on the margin in front. The investing membrane of the cœnobium, as usual, very delicate, and the cells, which were nearly spherical, were pressed close against it.

Genus VOLVOX Linn.

VOLVOX AUREUS var. HEMISPHÆRICUS, n.var. (Pl. lvi., f.19, 20).

Cœnobium muco investiente tenui; cellulis vertice visis circulatis, diametro inter se distantibus; a latere plus minusve hemisphæricis, basi plana. Cytoplasma granulis magnis amylaceis singulis instructum, stigmate ad marginem: vacuolis contractilibus 3 circa marginem; pyrenoidi nulla.

Cell. diam. 8-8$\frac{1}{2}\mu$. Lismore (311, 328).

The investing mucus of the cœnobium very thin, cells quite close to the edge. From above, the latter are circular, about one diameter apart, with a large amylaceous granule towards the centre, stigma at the margin, and three contractile vacuoles at intervals round the circumference. In side-view, the cells are more or less hemispherical, with a flat face closely adpressed to

the investing mucus. The connecting filament arises at the angle. In the shape of the cells, this form recalls *Volvulina Steinii*, which also has, sometimes, a series of c.v. round the circumference.

Volvox Carteri Stein. (Pl. lvi., f.21, 22).

Cœnob. diam. ad 900; cell. diam. 4-5, inter se distant. 7-10; zygo. immat. diam. 44-46, matur. ad 60μ.

Lismore (311, 327, 328).

Cf. Carter, Ann. Mag. Nat. Hist., Ser. 2, Vol. iii. I have not access, unfortunately, either to Carter's paper or to that of Stein (the species is not mentioned in his Naturg. d. Flagell.); but Lemmermann, Das Plankton schwedischer Gewässer, p.105, in one of his very useful little reviews of various genera, gives the name, with the remark that the zygotes "are said to possess an undulate membrane." By this character, I was able to recognise the species. The cœnobium is like that of *V. tertius* Meyer, with globular cells which, even under the $\frac{1}{12}$ obj., show no signs of connecting filaments. It is the immature zygote which has an undulate membrane (cell. diam. 31-33, lat. max. 44-46μ); when mature, the undulations have been produced into stout, slightly curved spines (cell. diam. 36-37, lat. max. 53-60μ). Several dozen zygotes in the cœnobium. I have the species from two places at Lismore; it would appear to be the first time that this *Volvox* has been recorded since Carter discovered it in India, fifty years, or so, ago.

Fam. PLEUROCOCCACEÆ.

Genus Elakatothrix Wille.

Elakatothrix gelatinosa Wille. (Pl. lvii., f.1, 2).

Cell. long. 15, lat. 3μ. Sydney Water-supply (100).

Cf. Wille, Conj. u. Chloroph., p.38, fig.18A-E; W. & G. S. West, Phytoplankton Eng. Lake Distr. (Naturalist, 1909), p.291, f.6. A cœnobium of four lately-divided cells ($8 \times 2\mu$), and a single full-grown cell ($15 \times 3\mu$) noted in the filtrates of the Sydney Water-supply. This organism bears a suspicious resemblance to *Spirotænia acuta* Hilse (*see* W. & G. S. West, Brit. Desm., i., Pl.

iii., f.14, 15). Known hitherto only from Norwegian and English lakes.

Genus Dactylotheca Lagerh.

Dactylotheca arcuatum, n.sp. (Pl. lvii., f.3, 4).

Cellulæ sparsæ in muco amorpho involutæ; fronte visæ linear-ellipticæ, quam levissime arcuatæ, apicibus obtusis; a latere rectæ, linear-ellipticæ, lateribus quam levissime convexis, apicibus obtusis; membrana tenui; chloroplastide tenuissima, parietali, minute granulosa, interdum in medio divisa; pyrenoidibus nullis.

Cell. long. 14 15, lat. 3-4μ. Lismore (302).

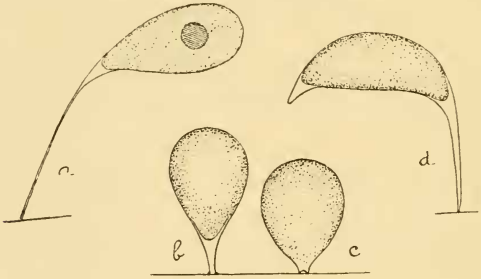
About 30 cells in a clump, irregularly disposed, enveloped in mucus. Cells linear-elliptic, straight in side-view but from the front arcuate, one side slightly concave, almost flat, the other distinctly convex, ends obtuse. Membrane thin; chloroplast delicate, parietal, pale green, minutely granular, sometimes divided in the middle, no pyrenoids.

Fam. PROTOCOCCACEÆ.

Genus Characium A.Br.

Characium guttula, n.sp. (Text-fig.6*a*).

Cellulæ corpore ovato levissime curvato, supra rotundato, subter



Text-fig.6.

(*a*) *Characium guttula*, n.sp.; (*b*, *c*) *Ch. cerassiforme* var. *minimum*, n.var.; (*d*) *Ch. ornithocephalum* A.Br.; (all × 1000).

rostrato in petiolum longum tenuissimum protracto; membrana tenui; chloroplastide interdum pyrenoidibus singulis continente.

Cell. long. max. 25-40; corp. long. 12-16, lat. 6-8μ.

Lismore (284, 286).

Cells drop-shaped, rounded above, pointed below, and drawn out into a slightly curved hyaline beak, which merges into a long thin hyaline stalk as in *Ch. longipes*. Membrane thin, chloroplasts sometimes containing a pyrenoid. Noted from two spots at Lismore, singly, or several in a clump, on filamentous algæ.

Characium cerassiforme v. minimum, n.var.

Cellulæ minutæ, supra rotundatæ nec deplanatæ; petiolo parvo aut nullo; magnitudine formæ typicæ triens.

Long. 14-18, lat. 10*μ*. Lismore.

Cf. *Ch. cerassiforme* Eich. & Racib., Nowe gat. zielenic, p.1, T. iii., f.12; also *Ch. pyriforme* A. Braun, Alg. unicell., p.40, T. v.B. About one-third the size of the type, and not flattened above. *Ch. cerassiforme* is more globose in the body of the cell than *Ch. pyriforme*. On *Tribonema*; (Text-fig.6*b*, *c*).

Characium ornithocephalum A.Br. (Text fig.6*d*).

Long. corp. 23, lat. 7½; petiol. long. 14*μ*. Lismore.

Fam. HYDRODASTRACEÆ.

Genus Urnella, gen.nov.

Character idem ac speciei.

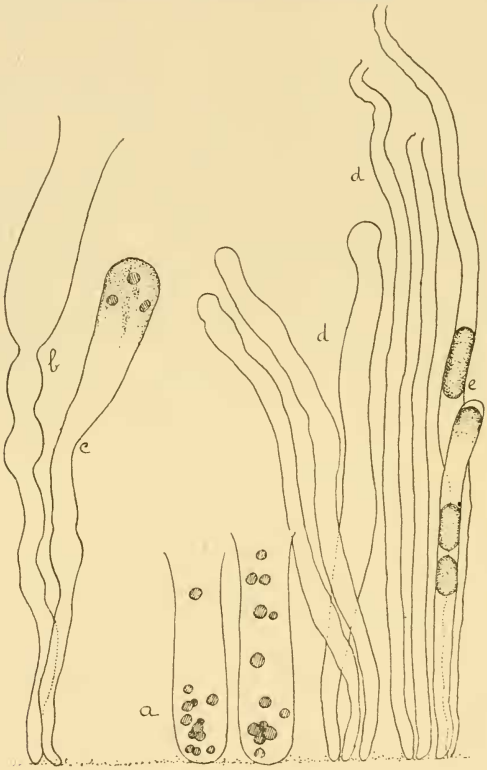
Urnella terrestris, sp.unica. (Text-fig.7*a-c*).

Cellulæ primum clavatæ, deinde dehiscione anguste-urniformes; lateribus subparallelis; ore everso; basi rotundata; aut humo sedentes aut tubulo inæquali longo erectæ. Membrana tenuis, hyalina. Chloroplastis parietalis in extrema cellula contracta: pyrenoidibus plurimis.

Corp. urniform. long. 60-90, lat. 12-20; tubul. long. ad 150, lat. 7-8*μ*. Auburn.

Noted in a green growth on a garden-path (clay) in very wet weather. The important part of the plant seems to be the long clavate cell which, at dehiscence, becomes a slender urn-shape, rounded below, with sides almost parallel, and the rim everted. This cell is sometimes seated on the ground, sometimes erected at the end of a fairly long irregular tubule of which it really forms the inflated head. Membrane thin and hyaline, the chlo-

roplasts deep green, parietal, collected at the end of the cell, and containing several pyrenoids. Reproduction apparently by zoogonidia. The plant bears a general resemblance to *Protosiphon* Klebs, but it does not form a series of *gemmæ*, nor does the apical



Text-fig. 7.

(*a*) *Urnella terrestris*, gen.nov. et sp., (×500); (*b*, *c*) tubular form (×330); (*d*) var. *abnormis*, n.var., (×500); (*e*) akinetes ?, (×500).

cell multiply by division, but seems to be entirely a gonidangium There is also a great likeness to *Codiolum gregarium* A.Br., but the latter has a thick cell-wall and a laminated *stipes*—"*stipitem elongatum hyalinum solidum* (*gelatina indurata farctum*)"—A. Braun, Alg. unicell., p.20, T. i.

Var. ABNORMIS, n.var. (Text-fig.7*d*).

Cellula tota tubiformis, longe protracta nec corpore urniformi in extremo instructa.

Cell. long. c. 150-200, lat. 7-10μ. Auburn.

In this form, found with the type, the cell, probably by excess of rain, is drawn out into a simple irregular tube, dehiscing at the end. There are none of the inflations in the tube which evidence previous attempts at forming the gonidangium. Reproduction probably by zoogonidia, and perhaps also by akinetes; (Text-fig.7*e*).

Fam. OOCYSTACEÆ.

Genus EREMOSPHÆRA De By.

EREMOSPHÆRA VIRIDIS v. TETRAEDRICA, n.var. (Pl. lvii., f.5).

Forma tetraëdrica, lateribus valde arcuatis, nodibus 4 levissime angulatis.

Cell. diam. 110μ. Lismore (308).

A curious form, in which the cell looks as if it were an inflated tetraëdron. The sides are well arched, and the angles only slightly marked.

The hypnospore of *E. viridis*, which was described and figured by me in *Oocystis* and *Eremosphæra*, p.116, f.6, I have lately noted again in a fresh gathering (316) from Lismore. Outer cell diam. 120, hypnospore 97μ. The scrobiculations are closer even than figured, being only about their diameter apart, and the scrobiculate membrane is backed, apparently, by the thick mucilaginous lining often found in *Eremosphæra*. The contents were green, but the chlorophyll seemed to be diffused in an even parietal layer, no distinct chloroplasts being visible.

Genus OOCYSTIS Näg.

OOCYSTIS ROTULA Playf. (Pl. lvii., f.6, 7).

Cœnob. diam. 50, autosp. diam. 12μ. Lismore.

Cf. Chodat, Entwickl. d. Erem. virid., f. 13, 21; Playfair, *Oocystis* and *Eremosph.*, p.130, Pl. vii., f.31. Cœnobium spherical, thin-walled, containing 8 spherical autospores. The latter are thick-walled, each with a central pyrenoid and cuneate chlo-

roplasts radiating out from it, six visible in optical section. It is very difficult to see how they show at the surface, probably as delicate discs. I had hardly finished congratulating myself on this find, when a *Chlamydomonas* with similar cell-contents turned up (from a different pool, however) and cast great suspicion on its validity as an *Oocystis*; (see *Chl. rotula*).

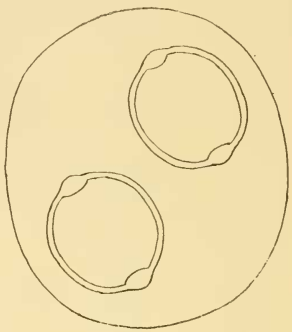
Oocystis nodulosa v. crassa, n.var. (Text-fig.8).

Forma præ longitudine crassior, subglobosa; membrana crassa; apicibus et interiore incrassatis et exteriore tuberculatis ut in forma typica.

Cell. long. 35, lat. 28½-29½; cell. matric. 84-74μ.

Lismore (308).

Cf. W. West, New Brit. Frw. Alg. (J.R.M.S. 1894), Pl. ii., f. 31. Our specimens are larger than the type, and proportionately ¼ broader, which makes them, therefore, subglobose, not oval. W. West gives long. 25-26, lat. 16-17μ as the dimensions.



Text-fig.8. *Oocystis nodulosa* var. *crassa* n.var., mother-cell with two autospores; (×500).

Oocystis lacustris v. natans (Lemm.) Playf. (Pl. lvii., f.8, 9).

Cœnob. long. 57, lat. 38; cell. long. 23, lat 12½μ.

Lismore (316).

Cf. *Oocystis* and *Eremosph.*, p.125, f.14*b*. Our specimens are the same diameter as the type, but a trifle longer; the chloroplast also is more reticulate. The shape of the mother-cell is characteristic of *O. lacustris*, as also the arrangement of the autospores, *l.c.*, Pl. vii., f.20.

Genus Franceia Lemm.

Franceia oblonga, n.sp. (Pl. lvii., f.10).

Cellulæ oblongæ nec ovales; membrana crassa; setis tenuissimis ubique vestitis.

Cell. long. 15, lat. 10; set. long. 15μ. Lismore (332).

Cf. *Francia ovalis* (Francé) Lemm. in Wille, Conj. u. Chloroph., p.59, f.31, which works out at $25 \times 15\frac{1}{2}\mu$. Our form, however, is distinctly oblong. The contents are deep green, showing signs of division into four parts.

Genus Lagerheimia Chodat.

Lagerheimia elliptica, n.sp. (Pl. lvii., f.11).

Cellulæ exacte ellipticæ, graciles, utroque polo setis longis subapicalibus binis instructæ. Cell. long. $12\frac{1}{2}$, lat. 6; set. long. 20μ.

Sydney Water-supply (100).

The nearest form to this, I know of, is *L. genevensis* v. *gracilis* Playf., (*L. ciliata* v. *gracilis*) Plankt. Sydney Water-supply, Pl. liii., f.10-12. The latter, however, is narrowly cylindrical, while this form is a perfect, slender ellipse.

Genus Bernardia Playf.

Bernardia tetraedrica, n.sp. (Pl. lvii, f.12).

Cellulæ sphæricæ, spinis longis cavis gracillimis 4, tetraëdrice ordinatis instructæ; spinis basi valde inflatis, apice obtusis.

Diam. c. spin. 30; corp. 5μ. Lismore (351).

This species consists of a single spherical cell with (apparently) the membrane drawn out into four long very slender hollow spines, arranged tetraëdrically. The spines are blunt at the extreme tip, not acutely pointed, and at the base are greatly inflated. Chloroplast delicate, pale green, parietal, confined to the central part of the cell. Cf. *Bernardia Chodati* (Bernard) Playf., Austral. Frw. Phytopl., Pl. lix., f.5, 6.

Genus Kirchneriella Schm.

Kirchneriella obesa W. & G. S. West. (Pl. lvii., f 13-16).

Cell. lat. 6-10, alt. 6-8, crass. $3\frac{1}{2}$-5μ. Clyde, Duck Creek (26).

Cf. W. & G. S. West, New Brit. Frw. Alg., p.16. Syn., *Selenastrum obesum* W. West, Alg. Eng. Lake Dist., p.22, Pl. x., f.50-52; *K. subsolitaria* G. S. West, Some Critical Green Algæ, p.285, Pl.20, f.20-30. Dimensions of the type, "diam. max. 6-9μ, crass. cell. 3-4·2μ"; of *K. subsolitaria*, "diam. max. 6-7μ, crass. cell. 2·9-3·2μ." I have found this form only once.

Genus TETRAEDRON Kütz.

TETRAEDRON GRANULOSUM, n.sp. (Pl. lvii., f.17, 18).

Cellulæ planæ, parvæ, triangulares; lateribus rectis in medio levissime convexis; angulis acutis haud inflatis; membrana grosse granulata, granulis in quincuncem ordinatis. A latere visæ, modice compressæ, elliptico-lanceolatæ, angulis acuminatis.

Cell. diam. 21, crass. 11μ. Lismore (302).

The specimens noted were flat, not tetrahedral, triangular with straight sides slightly convex in the centre; angles acute, not inflated; membrane coarsely granulate in quincunx. From the side, elliptic-lanceolate with pointed ends. In the centre of the cell might be discerned a minute nucleus enclosed in a pale brown globule (?pyrenoid). Sometimes the nucleus was entirely hidden by the globule, which then had the appearance of a large brown pyrenoid; cf. *Oocystis* and *Eremosphæra*, p.126, remarks on *O. lacustris* v. *paludensis*; and p.137 on *O. ovalis* v. *cylindracea*, where the same phenomenon occurs.

TETRAEDRON QUADRATUM f. MINOR Reinsch. (Pl. lvii., f.19).

Cellula plana; diam. sine spinis 17μ. Lismore.

Forma EXCAVATA, n.f. (Pl. lvii., f.20).

Forma plana, lateribus alternantibus concavis, alteris levissime convexis; angulis spinis brevibus acutis singulis armatis.

Cell. diam. 19, alt. 15μ, s.sp. Lismore. Cum priori.

Cf. Reinsch, Monog. *Polyedrium*, p.500, T. iv., fig.7*d*. This is a variant of f. *minor* with alternate sides concave, the other sides generally somewhat convex.

TETRAEDRON CAUDATUM v. AUSTRALE, n.var. (Pl. lvii., f.21, 22).

Cellulæ inæqualiter pentaëdricæ; angulis acutis, spinulis minutis singulis armatis; lateribus concavis; utrinque infra marginem angulis mammillatis armatis singulis instructæ. A latere, planæ (ichnographia universa respecta), lanceolato-ellipticæ, apicibus acutis armatis; altero latere convexæ, altero autem angulis mammillatis armatis binis projicientibus, instructæ.

Cell. lat. max. c. spinis 21μ. Lismore. Cum priori.

Cf. *Polyedrium pentagonum* Reinsch, Algenfl. v. Frank., T. iii., fig. ii.*c*(= *Tetr. caudatum* Corda) which is exactly the same shape but without the two mammillate angles which jut out from one side.

Tetraedron regulare v. octaedricum (Rein.) mihi.

Cellulæ angulis senis octonisve præditæ. (Pl. lvii., f.23).

Cell. diam. 17*μ*. Lismore.

Cf. *Polyedrium octaëdricum* v. *spinosum* Reinsch, Algenfl. v. Frank., p.78, T. v., fig. v., 1867. In this place, Reinsch has united two distinct types under one name* (*P. octaëdricum* Rein., Monog. *Polyedr.*, p.507, 1888). The first of these. T. v., fig. iv., must retain the specific name, while the other, T. v., fig. v., is evidently a form of *Tetr. regulare* Kütz. (= *P. tetraëdricum* Näg.), with from six to eight angles instead of four. Our specimens are the same shape as Reinsch's fig. v.*b*, but very much smaller; he gives lat. 38-47*μ*.

Tetraedron hastatum v. elegans Playf.

Cell. diam. c. proc. 30*μ*. Noted lately at Lismore (362), only known previously from Parramatta. *Cf.* Austral. Frw. Phytopl., p.845, Pl. lviii., f.27.

Tetraedron acutum v. rectilineare Playf.

Cell. diam. c. spin. 34-40*μ*, sp. long. 10*μ*. Confirmed from Lismore (362), only recorded previously from Enoggera; *ibidem*, p.845, Pl. lviii., f.26.

Tetraedron conicum, n.sp. (Pl. lvii., f.24).

Cellulæ tetraëdricæ; angulis conicis vix inflatis; apicibus muticis, obtuse-rotundatis; lateribus levissime concavis.

Cell. diam. 19-25*μ*. Lismore (362).

The cells are tetrahedral, composed of four conical angles meeting in the centre. The angles can hardly be called inflated, the sides of the cones being almost straight. The apices are bluntly rounded, without point or spine.

* *Polyedrium acuminatum spinosum* at the bottom of Plate v., *l.c.*, is either a slip of the pen or a printer's error.

Tetraedron minimum v. rectilineare Playf. (Pl. lvii., f.25).

Cell. long. 11½, lat. 10½μ. Botanic Gardens, Sydney (3).

Cf. Australian Freshwater Phytoplankton, these Proceedings, 1917, p.842, Pl.58, f.16, 17. Known to me previously only from Guildford. A rare form.

Tetraedron obtusum, n.sp. (Pl. lvii., f.26).

Cellulæ tetraëdricæ; lateribus rectis; angulis rostratis; rostris crassis quadratis, brevibus; apicibus truncatis.

Cell. diam. 21μ. Lismore (362).

Cell tetrahedral, sides straight, angles produced into a snub-nosed rostrum, the latter broad, quadrate, truncate.

Tetraedron trigonum Näg., forma (Pl. lvii., f.27, 28).

Forma lateribus in medio quam levissime retusis; spinis brevissimis oblique recurvis; membrana crassa.

Cell. diam. 36, crass. 20μ. Lismore (345).

Syn., *Polyedrium tetragonum* β *punctatum* (Kirchn.) Lag., Bidrag till Sveriges Algflora, p.62, T. i., f.28. *P. trigonum* e *punctatum* Kirchn., Alg. v. Schles., p.104 (*sec.* Lagerheim, *l.c.*). The type has sides simply arched, with or without a small straight spine at the angles. In this form, the sides are slightly flattened or retuse in the middle, and the spines are obliquely recurved. Our specimen was not punctate. For the type, *cf.* Nägeli, Gatt. einz Alg., T. iv.B, figs. 1*a* and 3*a*, *b* only.

Fam. HYDRODICTYACEÆ.

Genus Pediastrum Meyen.

Pediastrum simplex Meyen. (Pl. lvii., f.29, 30).

Cœnob. (cell. 4) c. proc. long. 35-50, lat. 33-48; s. proc. long. 17-24, lat. 16-22; cell. long. 24-34, lat. 12-17μ. Cœnob. (cell. 8) diam. 50-64; cell. long. 18-24, lat. 8-12μ.

Parramatta Park (99, 136).

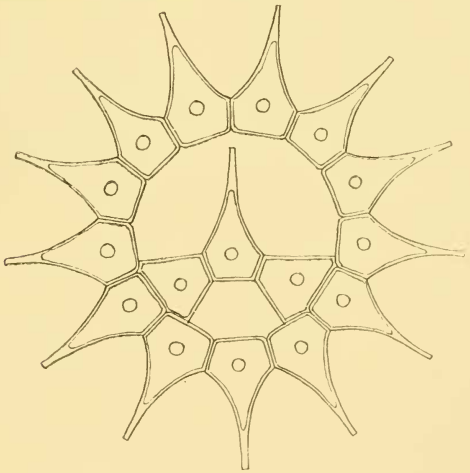
Meyen, Beob. üb einig. nied. Algenf., (1829) T. xliii., f.1. Syn., *P. simplex* var. *radians* Lemm., Zeitschrift f. Fischerei, 1897; *P. simplex* β *annulatum* Chodat, Alg. vertes, p.225, 1902; *P. simplex* v. *clathratum* f. *radians* (Lemm.) G. S. West, Third Tanganyika Exp., p.134, 1907.

Meyen gives five figures in illustration of his *P. simplex*, and these have since been arranged as three different variations. His fig.1 is var. *radians* Lemm.(1897); figs.2, 5 are f. *orata* (Ehr.) Racib., (*Asterodiction ovatum* Ehr., 1845); while figs. 3, 4 are f. *clathrata* Schröter (1883). One of his figures, however, must be left to represent the type, and it falls to fig.1 to do this, var. *radians* Lemm., being the last in order of priority. It seems to have been overlooked also, that Meyen himself arranged it so in the text. He says (*l.c.*, p.4) "*die unter Fig.1 möchte als die Norm zu betrachten seyn.*" The 8-celled cœnobium without central cells is, therefore, the type of *P. simplex*, and, incidentally also, of the genus *Pediastrum*.

Forma CLATHRATA (Schröter) Rac. (Text-fig.9).

Cœnob. diam. 60-92; cell. periph. long. 26-28, lat. 12*μ*.

Parramatta Park (99, 136).



Text-fig.9.

Pediastrum simplex f. *clathrata* (Schröter) Rac.; (× 660).

Schröter, in Jahresbericht d. Schles. Ges. für vaterländ. Cultur, 1883,p.182; Raciborski, Gatunki rodz. *Pediastrum*, 1889, p.8. Syn., *P. enoplon* W. & G. S. West, Frw. Alg. Madag., 1895, p.81, T. 5, f.1, 2; *P. clathratum* (Schröt.) Lemm., Forsch. Biol.

Stat. Plön, vii., 1899, p.20. A name that would take priority of Schröter's is *P. duodenarium* (Bail.) Rabh., Fl. Eur. Alg., iii., p.71, 1864, but, from Raciborski's notes, it would appear to include several different forms, *l.c.*, pp.9, 10.

Forma OVATA (Ehr.) Rac. (Pl. lvii., f.31).

Cœnob. (cell. 4) diam. 53; cell. long. 25, lat. 16μ.

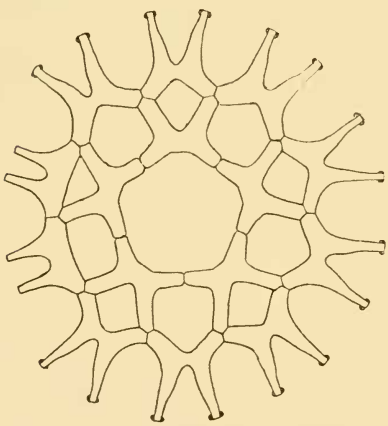
Parramatta Park (136).

Raciborski, Gatunki rodz. *Pediastrum*, 1889, p 8. Syn., *Asterodiction ovatum* Ehr., Ber. üb. d. Verh. d. Akad., 1845, p.71; *P. ovatum* (Ehr.) A.Br., Alg. unicell., 1855, p.81; *P. Sturmii* Reinsch, Algenfl. v. Frank., p.90, T. vii., f.1; *P. Schröteri* Lemm., Forsch. Biol. Stat. Plön, vii., 1899, p.20, T.2, f.33; *P. clathratum* f. *ovatum* (Ehr.) Schm., in Eng. Bot. Jahrb., xxxii., 1902, p.84 T.3, f.18.

All forms of *P. simplex* are very rare here; I have them from one spot only.

PEDIASTRUM DUPLEX v. RETICULATUM Lag. (Text-fig.10).

Cœnob. (cell. 4) diam. 52; cell. long. 16, lat. 14μ. Cœnob. (cell. permult.) long. 90-130, lat. 90-120; cell. long. 26-30, lat. 15-23μ.



Text-fig.10.
Pediastrum duplex var. *reticulatum* Lagerh.; (×500).

Sydney Water-supply (80, 81, 90, 100, 115); Botany (50).

Lagerheim, Stockholms Pedi., Protococc., o. Palm., p.56, T. ii., f. 1. Syn., *P. duplex* v. *clathratum* Schröter, Schwebefl. uns. Seen, p. 37, f.86. This form is common enough in the Sydney Water-supply, but rare elsewhere here. In the large cœnobium figured, the two dead cells on the left show that the early stage of the plant was more akin to *P. Boryanum*.

PEDIASTRUM BORYANUM (Turp.) Menegh. (Pl. lvii., f.32).

Forma; cœnobium e cellulis 4 exstructum. Cœnob. diam. 40μ.

Botany (15).

Var. HAYNALDII (Istv.) mihi. (Pl. lvii., f.33).

Cœnobium long. 180, lat. 155; cell. diam. 32μ.

Botanic Gardens (3).

P. Haynaldii Istvanffi, Jel. Magyar. Alg., 1888, p. 252, T. ii., f. 38. Syn., *P. angulosum* v. *araneosum* Rac., Gatunki rodz. *Pediastrum*, 1889, p.18, T. ii., f.40. This form is characterised by the fine ridging on the cell-wall. There is no difference between Raciborski's form and that of Istvanffi, save that in the latter the lines on the cell are granulate.

Var. AUSTRALE, n.var. (Pl. lvii., f.34).

Cellulæ perimetri cornibus plerumque brevibus; incisuris altis, oblongis, intus rotundatis, lateribus parallelis.

Cœnob. long. 116-150, lat. 100-127; diam. cell. 12-20μ.

Botanic Gardens (3).

A form of *P. Boryanum* common and widespread here, but apparently not so elsewhere. It is characterised by the shape of the marginal incisions, which are in the form of the letter U, oblong with rounded ends and parallel sides. The horns are generally short. The margin between the horns of the two adjacent cells is very slightly concave.

PEDIASTRUM BIRADIATUM var. BRAUNII (Wartm.) Chod.

Cell. long. 24, lat. 12μ. Kyogle (219). (Pl. lvii., f.35).

Cf. Chodat, Alg. vertes, p.230. Syn., *P. Braunii* Wartmann, Schw. Crypt. No.32.* *P. rotula* Ehr., (*non* Nägeli) in A. Braun, Alg. unicell., T. vi., figs.2, 5, 6. The dimensions of the peripheral cells of Braun's fig.5 work out at long. 22, lat. 13μ. *P. biradiatum* Meyen, is extremely rare; I have never come across the type, and only one specimen of the variation. The lobules of the cells are bifid in this form, only incised in the type.

* Not having seen Wartmann's type, I simply follow Chodat in the synonymy. Lagerheim, however, Veg. süssw. plankt. Bären-Insel, p.10, and Borge, Algenfl. v. Schweden, p.60, identify it with *P. tricornutum* Borge.

Pediastrum tetras var. Crux Michæli (Rein.) Playf.

Cell. diam. 18μ. Botany (109). (Pl. lvii., f.36).

Noted also in the Sydney Water-supply, these Proceedings, 1913, p.518, Pl.56, f.6. In the specimen here figured, the cells were closely appressed, and the slits were observable through which the zoogonidia had escaped.

Fam. CŒLASTRACEÆ.

Genus Tetrastrum Chodat.

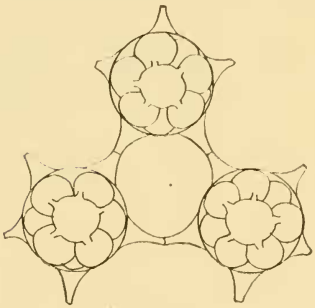
Tetrastrum elegans v. dentatum Playf.

Cœnob. c. spin. diam. 32; corp. 8; sp. long. 12; dent. long. 2-3μ. Lismore (258).

Cf. Austral. Frw. Phytopl., p. 833, Pl. lvii., f. 7. Hitherto known only from Parramatta; this form is now confirmed from Lismore.

Genus Cœlastrum Näg.

Cœlastrum reticulatum (Dang.) Senn. (Text-fig. 11).



Text-fig. 11.*

Cellulæ matric. diam. 14μ; cell. cœnob. filial. 6μ.

Parramatta Park (136).

Syn., *Hariotina reticulata* Dangeard, Mem. s. l. algues, ii., 1889. Generally found in plankton-gatherings as broken cœnobia. In this case, six cells were noted, partially united by their processes, each with a perfectly formed autocolony within.

EXPLANATION OF PLATES LIV.-LVIII.

Plate liv.

Fig. 1.—*Oscillatoria flexa*, n.sp.; (× 660).

Fig. 2.—*O. simplicissima* v. *granulata*, n.var.; (× 1000).

Fig. 3.—*O. simplicissima* v. *constricta*, n.var.; (× 660).

Fig. 4.—*O. princeps* Vaucher; portion of an empty filament, showing the thick sheath and permanent dissepiments; (× 330).

Fig. 5.—*Phormidium grande*, n.sp.; (× 500).

* *Celastrum reticulatum* (Dang.) Senn, three isolated cells of a cœnobium, each containing an autocolony; (× 1000).

Figs 6, 7.—*Ph. numarium*, n.sp.; (6) × 1330, (7) × 2000.

Figs. 8, 9.—*Anabæna australica*, n.sp.,(× 1000); (8) cells and heterocyst of infertile trichome; (9) part of a fertile trichome; the constrictions of the cells can be discerned only with the $\frac{1}{12}$ in. obj.

Fig. 10.—*A. australica* var. *constricta*, n.var.; (× 1330).

Figs. 11-13.—*A. variabilis* var. *cylindracea*, n.var. (× 1000); (11) cells and heterocyst; (12) immature catenate gonidia; (13) mature spore.

Fig. 14.—*A. oscillarioides* var. *crassa*, n.var.; (× 660).

Figs. 15, 16.—*A. laxa* var. *hortensis*, n.var., (× 1000); (15) cells and heterocyst; (16) cells and spore.

Figs. 17-21.—*Cylindrospermum stagnale* var. *australe*, n.var.; (17, 18) with conical heterocysts(× 1000); (19, 20) with oblong heterocysts(× 660); (21) coiled trichome.

Figs. 22, 23.—*C. rectangulare* Playf.; (22) trichome with thin-walled immature spore (× 1000); (23) with mature thick-walled spore (× 660).

Figs. 24, 25.—*C. rectangulare* var. *parricellula*, n.var. (× 1000); (25) trichome with apical cell.

Figs. 26, 27.—*C. Goetzei* Schm., forma; (× 1000).

Plate lv.

Figs. 1, 2.—*Carteria rugulosa*, n.sp.; (2) endview; (× 1000).

Fig. 3.—*C. rugulosa* var. *angulata*, n.var.; (× 1000).

Fig 4.—*C. rugulosa* var. *inæqualis*, n.var.; (× 1000).

Figs. 5, 6.—*C. multifilis* (Fresen.) Dill, formæ; (× 1330).

Figs. 7, 8.—*C. granulosa*, n.sp.; (8) sideview; (× 660).

Figs. 9, 10.—*Chlamydomonas reniformis*, n.sp.; (10) sideview; (× 1000).

Fig. 11.—*Chl. Lismorensis* var. *gracilis*, n.var.; (× 2000).

Fig. 12.—*Chl. rotula*, n.sp.; (× 1000).

Fig. 13.—*Chl. alpina* Wille; (× 2000).

Fig. 14.—*Chl. caudata* Wille; (× 1000).

Figs. 15-17.—*Chl. maculata*, n.sp.; (15) × 1330; (16) with stratified cell-wall (× 660); (17) mother-cell (× 660), autospores (× 1000); for convenience, the cœnobium is drawn smaller, and the autospores therefore appear more crowded than natural; the latter are in optical section, the spotted surface of the chloroplast being omitted; the flagella were just as figured.

Fig. 18.—*Chl. maculata* var. *oblonga*, n.var.; (× 1330).

Fig. 19.—*Chl. maculata* var. *planktonica*, n.var.; (× 1000).

Fig. 20.—*Chl. metastigma* Stein; (× 1000).

Figs. 21, 22.—*Chl. paupercula*, n.sp.; (21) × 2000; (22) × 1800.

Fig. 23.—*Chl. pusilla*, n.sp.; (× 660).

Fig. 24.—*Chl. angulosa* var. *obesa*, n.var.; (× 1330).

Fig. 25.—*Chl. pisiformis* var. *ocellata*, n.var.; mother-cell and autospores; (× 1000).

Fig. 26.—*Chlorogonium minimum*, n.sp.; (× 1330).

Figs. 27, 28.—*Pteromonas angulosa* var. *australis* Playf., forma; (× 1000).

Fig. 29.—*Pt. angulosa* var. *scutiformis*, n.var.; (× 1330).

Fig. 30.—*Pt. angulosa* var. *vexilliformis*, n.var.; (× 1330).

Plate lvi.

Figs. 1-3.—*Synura granulosa* Playf.; (1) elongate cœnobium with zooids attached to a central mucous peduncle (× 660); (2, 3) individual zooids showing one or more dark red granules near the anterior end (× 1000).

Fig. 4.—*Tessellaria volvocina* Playf., supposed free zooid; (× 1500).

Figs. 5, 6.—*Xanthodiscus Lauterbachi* Schew., (so-called); (5) face-view of a preserved specimen with shrunken contents showing central nucleus, but no chlamydomonadine arrangement of the chromatophore; (6) sideview; (× 1000).

Figs. 7, 8.—*Phacotus crassus*, n.sp., (× 1000); (8) sideview.

Figs. 9, 10.—*Ph. glaber*, n.sp., (× 1000); (10) sideview.

Figs. 11, 12.—*Ph. glaber*, formæ; (× 1000).

Figs. 13, 14.—*Ph. australis*, n.sp., (× 1000); (14) sideview.

Fig. 15.—*Spondylomorum quaternarium* Ehr.; (× 1000).

Figs. 16, 17.—*Sp. quaternarium* var. *rostratum*, n.var., (× 1000); (16) bunched cœnobium; (17) rosette-form.

Fig. 18.—*Volvulina Steinii* Playf., single cell of a cœnobium, in sideview, showing nucleus, contractile vacuoles, and stigma in the usual chlamydomonadine positions.

Figs. 19, 20.—*Volvox aureus* var. *hemisphæricus*, n.var.; (19) cells from above (× 660); (20) three cells in sideview (× 1000).

Figs. 21, 22.—*Volvox Carteri* Stein; (21) immature zygote as described by Carter (× 660); (22) mature zygote (× 500).

Plate lvii.

Fig. 1.—*Elakatothrix gelatinosa* Wille, isolated cell; (× 1330).

Fig. 2.—*E. gelatinosa*, mucous matrix with newly divided cells; (× 1000).

Figs. 3, 4.—*Dactylothece arcuatum*, n.sp., two cells, of many noted, involved in a mucous matrix (× 1330); (3) face-view; (4) sideview.

Fig. 5.—*Eremosphæra viridis* var. *tetraëdrica*, n.var.; (× 270).

Fig. 6.—*Oocystis rotula* Playf., mother-cell with autospores; (× 660).

Fig. 7.—*O. rotula*, autospore; (× 1100).

Fig. 8.—*O. lacustris* var. *natans* (Lemm.) Playf., mother-cell with autospores; (× 660).

Fig. 9.—*O. lacustris* var. *natans*, autospore, showing fragmented, reticulate chloroplast; (× 1000).

Fig. 10.—*Franceia oblonga*, n.sp.; the setæ are, for convenience, figured much shorter than natural; they should be as long as the cell; (× 1330).

Fig. 11.—*Lagerheimia elliptica*, n.sp.; (× 1330).
Fig 12.—*Bernardia tetraëdrica*, n.sp.; (×1000).
Figs. 13-16.—*Kirchneriella obesa* W. & G. S. West; (× 1000).
Figs. 17, 18.—*Tetraëdron granulosum*, n.sp.; (17) face-view; (18) sideview (× 1000).
Fig. 19.—*Tetr. quadratum* f. *minor* Reinsch; (× 800).
Fig. 20.—*Tetr. quadratum* f. *excavata*, n.f.; (× 800).
Figs. 21, 22.—*Tetr. caudatum* var. *australe*, n.var.; (21) face-view; (22) side; (× 1000).
Fig. 23.—*Tetr. regulare* var. *octaëdricum* (Reinsch) mihi; (× 1000).
Fig. 24.—*Tetr. conicum*, n.sp.; (× 1000).
Fig. 25.—*Tetr. minimum* var. *rectilineare* Playf.; (× 1000).
Fig. 26.—*Tetr. obtusum*, n.sp.; (× 1000).
Figs. 27, 28.—*Tetr. trigonum* Näg., forma: (27) face-view; (28) side; (× 660).
Figs. 29, 30.—*Pediastrum simplex* Meyen, 4-celled forms; (× 660).
Fig. 31.—*Pedi. simplex* f. *ovata* (Ehr.) Racib.; (× 660).
Fig. 32.—*Pedi. Boryanum* (Turp.) Menegh., 4-celled form; (× 500).
Fig. 33.—*Pedi. Boryanum* var. *Hayualdii* (Istv.) mihi; (× 500).
Fig. 34.—*Pedi. Boryanum* var. *australe*, n.var.; (× 660).
Fig. 35.—*Pedi. biradiatum* var. *Braunii* (Wartm.) Chodat; (× 660).
Fig. 36.—*Pedi. tetras* var. *Crux Michaeli* (Reinsch) Playf.; (× 1000).

Plate lviii.

Spirogyra neglecta (Hass.) Kütz.

Fig. 1.—Conjugated filaments with elliptic zygospores and non-inflated sporangial cells; (× 220).

Fig. 2.—Conjugated filaments with oval zygospores and inflated sporangial cells; (× 220). Figs. 1 and 2 formed part of one and the same scalariform filament.

Figs. 3-6.—Four types of zygospore in the one gathering (× 400); fig. 5 (× 500).

Figs. 7, 8.—Unaltered cells of a conjugated filament, with simple delicate chloroplast; (8) × 330; (7) chloroplast much enlarged.

Figs. 9, 10.—Long cell of a vegetative filament, with delicate, fimbriate chloroplast and minute pyrenoids; (9) chloroplast much enlarged; (10) × 330; the fringed edge of the chloroplast is too delicate to be seen under this low magnification.

Figs. 11-13.—Cells with more robust, scalloped chloroplast; (11) chloroplast much enlarged; (12) short inflated cells probably about to conjugate (× 330); (13) long uninflated cell of vegetative filament (× 330).

Figs. 14-16.—*Spirogyra neglecta* var. *amylacea*, n.var., vegetative filaments and chloroplast; (14) long cell (× 330); (15) short cells (× 330); (16) chloroplast enlarged Conjugating cells and zygospores of this variation as in fig. 1.